$$+\tfrac{1}{360}\int_0^{\frac{1}{4}\pi}(4\sin^2\theta+2\cos^2\theta+42\sin\theta\cos\theta-12\sin\theta\cos^3\theta-20\sin^3\theta\cos\theta+\sec^8\operatorname{cosec}^2\theta$$

$$+6\sec^7\theta\operatorname{cosec}\theta-60\sec^2\theta\operatorname{cosec}\theta-6\sec\theta\operatorname{cosec}\theta-36\tan\theta+10\tan^2\theta$$

$$+20\tan^3\theta-\cot^2\theta+20\operatorname{cosec}^2\theta+123\sec^2\theta-50\tan\theta\sec^2\theta+5\tan^2\theta\sec^2\theta$$

$$+14\tan^3\theta\sec^2\theta-103\tan^4\theta\sec^2\theta+186\tan^5\theta\sec^2\theta-236\tan^6\theta\sec^2\theta$$

$$+192\tan^7\theta\sec^2\theta-60\tan^8\theta\sec^2\theta+36\tan^9\theta\sec^2\theta+84\tan^{10}\theta\sec^2\theta$$

$$+45\tan^{12}\theta\sec^2\theta)d\theta=\tfrac{11}{40}\tfrac{9}{0}\tfrac{9}{4}\tfrac{2}{0}\tfrac{7}{0}-\tfrac{11}{144}\log 2.$$

$3p'=\tfrac{3}{4}\tfrac{5}{0}\tfrac{9}{0}\tfrac{7}{4}\tfrac{8}{0}\tfrac{1}{0}-\tfrac{1}{4}\tfrac{1}{8}\log 2$, $p=1-3p'=\tfrac{1}{4}\tfrac{1}{8}\log 2+\tfrac{4}{4}\tfrac{0}{0}\tfrac{6}{0}\tfrac{1}{4}\tfrac{9}{0}$. $\therefore\ p=.260292$.

124. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College, Defiance, Ohio.

Find the average area of a spherical polygon of $n=6$ sides.

No solution of this problem has been received.

MISCELLANEOUS.

118. Proposed by O. W. ANTHONY, New York, N. Y.

If f is determined by the equation $f(\mu\nu)=f(\mu)f^{-1}(\nu)+f(\nu)f^{-1}(\mu)$, where f^{-1} is the inverse of f, show that $f[(2)^\mu]=\frac{k^{\mu+1}}{2^{\mu+1}}$, where k is a constant.

Solution by G. B. M, ZERR, A.M., Ph.D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

$f(\mu\nu)=ff^{-1}(\mu\nu)+ff^{-1}(\mu\nu)$, but $ff^{-1}=1$. $\therefore f(\mu\nu)=2(\mu\nu)$. $\therefore f=2$.

$\therefore (2)^\mu=(f)^\mu$ or $f[(2)^\mu]=(f)^{\mu+1}=(2)^{\mu+1}$.

$\therefore f[(2)^\mu]=(\frac{1}{2}k)^{\mu+1}$, where $k=4$.

119. Proposed by L. C. WALKER, A. M., Graduate Student, Leland Stanford Jr. University, Cal.

Show how to determine the illumination at any point of the surface of the water at the bottom of a deep well, due to the light from the sky.

A solution of this problem appeared in the November number. The problem was incorrectly numbered. ED.

120. Proposed by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, England.

Prove $\Sigma\cos^4 x-2\Pi\cos^2 x+2\Pi\sin^2 x=1-\sin(\Sigma)\sin\Pi(y+z-x)$.

Solution by G. B. M. ZERR, A. M., Ph.D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

$$\sin(\Sigma)\sin\Pi(y+z-x)$$

$$=\sin(x+y+z)\sin(x+y-z)\sin(z-y+x)\sin(z+y-x)$$

$$=[\sin^2(x+y)-\sin^2 z][\sin^2 z-\sin^2(y-x)]$$

$$=\sin^2 z[\sin^2(x+y)+\sin^2(y-x)-\sin^4 z-\sin^2(y+x)$$

$$=2\sin^2 x\sin^2 y+2\sin^2 x\sin^2 z+2\sin^2 y\sin^2 z-4\sin^2 x\sin^2 y\sin^2 z-\sin^4 x$$
$$-\sin^4 y-\sin^4 z$$

$$=2\Sigma\sin^2 \Pi(xz)-4\Pi\sin^2 x-\Sigma\sin^4 x.$$

$$1-\sin(\Sigma)\sin\Pi(y+z-x)=1+\Sigma\sin^4 x+4\Pi\sin^2 x-2\Sigma\sin^2\Pi(xy)....(1).$$

$$\Sigma\cos^4 x-2\Pi\cos^2 x+2\Pi\sin^2 x=\cos^4 x+\cos^4 y+\cos^4 z-2\cos^2 x\cos^2 y\cos^2 z$$
$$+2\sin^2 x\sin^2 y\sin^2 z=1+\sin^2 x+\sin^4 y+\sin^4 z+4\sin^2 x\sin^2 y\sin^2 z$$
$$-2\sin^2 x\sin^2 y-2\sin^2 x\sin^2 z-2\sin^2 y\sin^2 z$$
$$=1+\Sigma\sin^4 x+4\Pi\sin^2 x-2\Sigma\sin^2\Pi(xy)....(2).$$

$\therefore$ (1)=(2). $\sin(a+b)\sin(a-b)=\sin^2 a-\sin^2 b$ gives (1).

No solutions of Problems 121, 122, 123, and 127 have been received. ED.

NOTES.

BIOGRAPHICAL SKETCH OF THE LATE HON. JOSIAH H. DRUMMOND.

The story of the life of Dr. Drummond when fully written would comprise a large part of the political history of the State of Maine during the last half a century. Only the leading facts in his life can here be narrated. For a more extended narrative of his life, the reader is referred to the newspapers of Portland, Maine, all of which at the time of his death gave very fully the leading events of his life.

Josiah H. Drummond was born in Winslow, Maine, August 30, 1827, and died at Portland, Maine, October 25, 1902. He graduated from Colby in 1846; read law in the office of Boutelle & Noyes in Waterville; was admitted to the bar of Maine in 1850, and to the bar of California, to which State he made a business trip, in 1851; returned to Maine and began the practice of law at Waterville; left the democratic party in 1855 on the anti-slavery issue and became one of the founders of the Republican party; was elected to the House of Representatives of Maine in 1857 and 1858, serving as Speaker; elected to State Senate in 1859, he was almost immediately after the beginning of the session elected attorney general and was three times re-elected; removed to Portland in 1860, was elected to the House from Portland in 1869, and declined a re-election in 1870; reeeived the degree of LL. D. from Colby College in 1871. He was a practicing lawyer, vice president of the trustees of Colby; a director of the Union Mutual Life Insnrance Company, and of the Union Safe Deposit and Trust Company, and clerk of the Maine Central corporation.